Chemistry Quiz
Electrochemistry
Version B

Directions

- Mark your answers to the multiple-choice questions on the answer sheet at the end of the multiple-choice section. Use a blue or a black pen.
- Remember to complete the submission information on every page you turn in.

Multiple-Choice Questions

Time Limit: You have 20 minutes to compete this section.
Scoring: 5 points each; 50 points total; 1.25-point deduction for each incorrect answer.

1. **The oxidation number of the sulfur atom in SO_3^{2-} is:**
   - **A.** 1
   - **B.** 2
   - **C.** 4
   - **D.** 6
   - **E.** 8

2. **For a nonspontaneous reaction, which of the following sets of conditions is true?**
   - **A.** $\Delta G^o > 0$, $K > 1$, and $E^o > 0$
   - **B.** $\Delta G^o > 0$, $K < 1$, and $E^o < 0$
   - **C.** $\Delta G^o > 0$, $K > 1$, and $E^o < 0$
   - **D.** $\Delta G^o < 0$, $K < 1$, and $E^o < 0$
   - **E.** $\Delta G^o < 0$, $K > 1$, and $E^o > 0$

3. **What will happen when a piece of Magnesium metal is dropped into a beaker containing a 1 M solution of Copper(II)Chloride?**

   $$Mg^{2+} + 2e^- \rightarrow Mg(s) \quad E^o = -2.37\ V$$
   $$Cu^{2+} + 2e^- \rightarrow Cu(s) \quad E^o = +0.34\ V$$

   - **A.** The magnesium will dissolve but nothing else will happen.
   - **B.** The copper will dissolve and the Magnesium will be deposited.
   - **C.** The magnesium will dissolve and the copper will be deposited.
   - **D.** The magnesium will dissolve and chloride gas will be produced.
   - **E.** There will be no reaction.

4. **How many electrons are transferred in the following reaction as written?**

   $$3Ca\ (s) + 2AuCl_3\ (aq) \rightarrow 3CaCl_2\ (aq) + 2Au\ (s)$$

   - **A.** 2
   - **B.** 4
   - **C.** 6
   - **D.** 8
   - **E.** 9

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5. **Which is the correct standard cell notation for a cell whose combined reaction for the anode and cathode is (a platinum electrode is also used):**

   $Zn(s) + 2H^+(aq, 1M) \rightarrow Zn^{2+}(aq, 1M) + H_2(g, 1\ atm)$

   A. $Zn(s)|Zn^{2+}(aq, 1M)||H^+(aq, 1M)|H2(g, 1\ atm)|Pt(s)$
   B. $Zn^{2+}(aq, 1M)|Zn(s)\ ||H2(g, 1\ atm)\ |H2(g, 1\ atm)|Pt(s)$
   C. $H^+(aq, 1M)|H2(g, 1\ atm)|Pt(s)||Zn(s)|Zn^{2+}(aq, 1M)$
   D. $Zn(s)|H^+(aq, 1M)||Zn^{2+}(aq, 1M)|H2(g, 1\ atm)|Pt(s)$
   E. $H_2(g, 1\ atm)|Zn^{2+}(aq, 1M)||H^+(aq, 1M)|Zn(s)|Pt(s)$

6. **A salt bridge is needed in a Galvanic Cell in order to:**
   A. allow the passage of electrons from one half-cell to another.
   B. allow the passage of ions from one half-cell to another.
   C. allow the transfer of reactants from one half-cell to another.
   D. prevent the passage of electrons from one half-cell to another.
   E. prevent the passage of ions from one half-cell to another.

7. **The standard free-energy change for the reaction shown below is:**

   $Zn(s) + Cu^{2+}(aq, 1\ M) \rightarrow Zn^{2+}(aq, 1\ M) + Cu(s)$ $E^o = -0.763$ V

   A. $\Delta G^o_{rxn} = -(2\ mol\ e^-)(96{,}500\ C/mol\ e^-) \div (-0.763)$
   B. $\Delta G^o_{rxn} = +(2\ mol\ e^-)(96{,}500\ C/mol\ e^-)(-0.763)$
   C. $\Delta G^o_{rxn} = \mathbf{+}(3\ mol\ e^-)(96{,}500\ C/mol\ e^-)(-0.763)$
   D. $\Delta G^o_{rxn} = -(3\ mol\ e^-)(96{,}500\ C/mol\ e^-) \div (-0.763)$
   E. $\Delta G^o_{rxn} = -(2\ mol\ e^-)(96{,}500\ C/mol\ e^-)(-0.763)$

8. **Which of the following statements is true:**
   A. All electrochemical cells produce electricity.
   B. An electrochemical cell will require an input of electricity if it has a positive E^o_{cell}
   C. When determining the cell potential for an overall reaction, the standard cell potentials of the half-reactions must be multiplied by the coefficients in the balanced equation.
   D. The cathode is the point where electrons are consumed and to which cations travel.
   E. At equilibrium, $E_{cell} > 0$ and $Q > K$

9. **Standard conditions in electrolytic cells are:**
   A. 1 atm for gases, 1 Molar for solutions, and 25ºC
   B. 1 atm for gases, 0.10 Molar for solutions, and 0ºC
   C. 0 atm for gases, 1 Molar for solutions, and 0ºC
   D. 1 atm for gases, 0 Molar for solutions, and 25ºC
   E. 0ºC, and 1 atm for gases is all that is specified.

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10. A voltaic cell has an anode of A/A^+ and a cathode of metal B/B^+. The initial concentrations of A^+ and B^+ are such that $E^o_{cell} < E_{cell}$. Which of the following statements is true for how $[A^+]$, $[B^+]$, and E_{cell} changes as the cell operates?

A. $[A^+]$ and $[B^+]$ both decrease, while E_{cell} increases.
B. $[A^+]$ decreases, $[B^+]$ increases, while E_{cell} increases.
C. $[A^+]$ increases, $[B^+]$ increases, while E_{cell} decreases.
D. $[A^+]$ increases, $[B^+]$ decreases, while E_{cell} decreases.
E. All values stay the same because the cell is at standard conditions.

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Full Name: _____User Name: _____Date: _____
(print clearly)

Answer Sheet

Enter the correct answer for each of the multiple-choice questions.

1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

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Chemistry Quiz
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Full Name: _____User Name: _____Date: _____
(print clearly)

Free Response

Directions

- Neatly write your responses in the spaces provided. Use a blue or a black pen.
- Don't write in the margins.
- Remember to complete the submission information on every page you turn in.

Free-Response Questions
Time Limit: You have 30 minutes to complete this section.
Scoring: 60 points total; Question 1 is worth 35 points and Question 2 is worth 25 points; points for each section are indicated within the questions.
Calculator Use: You may use a calculator on both questions.

1. **Molecular bromine (Br_2) is added to a solution containing NaI and NaF. The Na+ is inert and does not react. Predict what reactions will occur, if any, at standard conditions.**

   I_2 (s) + $2e^-$ → $2I^-$ (aq, 1M) E^o = 0.53 V
   Br_2 (s) + $2e^-$ → $2Br^-$ (aq, 1M) E^o = 1.07 V
   F_2 (s) + $2e^-$ → $2F^-$ (aq, 1M) E^o = 2.87 V

   A. **Write the half-reactions that will occur.** (10 points)

   B. **Write the overall reaction(s) that will occur.** (5 points)

   C. **Determine the E^o_{cell} of the reaction(s) in part B.** (5 points)

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D. Determine the ΔG^o_{rxn} of one reaction from part C. (There may or may not be only one reaction to choose from). (10 points)

E. Does the ΔG^o_{rxn} you calculated support your conclusions from part A? Explain. (5 points)

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2. Use the following reaction to answer questions A through C:

$Mg(s) + Al^{+3}(aq) \Leftrightarrow Mg^{2+}(aq) + Al(s)$

$Mg^{2+} + 2e^- \rightarrow Mg\ (s)$ $\quad E^o_{cell} = -2.37$ V
$Al^{3+} + 3e^- \rightarrow Al\ (s)$ $\quad E^o_{cell} = -1.66$ V

A. Balance the reaction, showing all work. (10 points)

B. Predict whether the reaction would proceed spontaneously as written (in the forward direction) if the $[Al^{3+}] = 0.65$ M and $[Mg^{2+}] = 0.012$ M at 25°C. Show all work. (10 points)

C. What is true for E_{cell} and Q at equilibrium? (5 points)

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